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BOTANY

The Translocation of Foliar Applied P-32 in Field Grown Corn, With Respect to Fruit Development[1]

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Introduction: Absorption, and the subsequent translocation of materials from the leaves of plants, is a phenomenon of common occurrence and the subject has been extensively reviewed in recent years (Arisz, 1952; Biddulph, 1959; Boynton, 1954; Swanson, 1959; Williams, 1955; Wittwer and Teubner, 1959). Foliar absorption and translocation is important physiologically for it bears upon the problems of foliar nutrition and herbicide and fungicide action in plants as well. The translocation of substances from "supply" leaves to metabolically active "sinks" is also part of this problem and has received attention in this laboratory particularly with respect to the accumulation of translocated materials by developing fruits.

Linck and Swanson (1960) studied the movement of P-32 from various leaves of *Pisum sativum* to the first developing fruit and concluded that 70 to 90% of the P-32 which moves out of the bloom node leaf is transported to the fruit at that node. They also concluded that the only other leaf that contributed a significant amount of P-32 to this same fruit was the leaf below it in phyllotaxic rank. Linck and Sudia (1962) and Sudia and Linck (1962) were also able to confirm a similar relationship of transport from the bloom node leaf to the fruit in *P. sativum* for C-14-labeled photo-synthate and Zn-65.

Ahlgren (1962), in studies of P-32 transport in soybean (*Glycine max*), concluded that P-32 applied foliarly is translocated preferentially to the fruits at the node of treatment and to the fruits at the node below.

To ascertain the extent to which a similar specificity of transport might occur between the leaf and the ear at the same node in corn, studies were undertaken with mature corn in the field. The objective of these studies was to delineate the pattern of movement of P-32 from the 7th leaf of the corn plant with respect to the development of the fruit of the corn plant at that node.

Materials and Methods: Corn grains of the variety Minhybrid 507 were planted according to good agronomic practice in the field laboratory on the Plant Pathology and Botany Farm at the Agricultural Experiment Station, Rosemount, Minnesota. Sixty-five days after planting, radioisotope treatments were begun. Plants were treated at intervals of 3 days early in the experiments and later at 5-days until the plants were 125 days old; a total of 17 treatments was made.

For each treatment, 3 plants selected for uniformity of development were used. Each of the 3 plants were treated by placing 50 μc of P-32 in a 10-lambda drop of 20 mM NaH_2PO_4 carrier solution on the surface of the 7th leaf midway between the base and tip and near the midrib. The 7th leaf subtended the first developed ear of the corn variety used. The radioisotope, as received from the Oak Ridge National Laboratory, was carrier free $H_3P^{32}O_4$ dissolved in HC1. These samples were dried on a hot plate and re-dissolved in 20 mM NaH_2PO_4. The NaH_2PO_4 increased the pH and provided a small amount of carrier phosphate.

The treated plants were allowed a 4-hour uptake period after which they were harvested and dissected at the field laboratory into the following parts: plant parts above the treated node, plant parts below the treated node, and the ear and husk at the treated node. Neither

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the root nor the treated leaf were harvested for assay. The dissected plant parts were placed in paper bags and dried in an oven at 105°C for 3 days. The dried plant material was then completely dissolved in a large volume of boiling concentrated nitric acid in a 2-liter beaker. When complete dissolution of the plant material had occurred, as evidenced by the clarity of the solution and the cessation of foaming, a 10-ml sample was removed to a 30-ml high wall beaker and taken to dryness on an electric hot plate. The volume of the liquid remaining in the large beaker was measured and an appropriate correction based on this volume was applied to the subsequent radiological assay.

The assay of radioactivity was accomplished by counting the residue in the 30-ml beaker with a Geiger tube and scaler. The counts per minute of P-32 activity for each plant part were calculated as a percentage of the total amount of P-32 activity that had been translocated from the treated leaf. Self absorption was considered negligible and radioactive decay was calculated to the time of radioisotope application to the leaves.

Results and Discussion: The results are summarized in Fig. 1. In it are plotted the percentages of the total amount of P-32 translocated from the 7th leaf to the plant parts above the treated leaf, the plant parts below the treated leaf and the ear and husk at the treated node. Each point in the figure is an average of three observations; the treatments on any 1 day are the averages of 3 complete plants.

The pattern of movement of P-32 from the leaf at the 7th node of this corn variety showed no particular specificity for the ear at that node. Rather, there seemed to be a general pattern of distribution where no part of the plant dominated the pattern in any consistent manner. In addition the amount received by any 1 part seemed to fluctuate widely day to day and on a number of widely separated occasions the P-32 seemed to be distributed equally among the plant parts. There appeared to be no trend in either the direction of movement or accumulation with age.

The pattern of movement exhibited by corn is quite different from that described for *G. max* and *P. sativum* where there is great specificity of P-32 movement to the fruit (Linck and Swanson, 1960). The great variability in the amount of P-32 translocated to the ear in corn may indicate that leaves other than the one subtending the ear may supply its phosphorus. In corn, the vascular bundles from 1 leaf may traverse 2 to 8 nodes from which the leaf is inserted without anastomosis thereby providing an unimpeded connection to another node and leaf. The pattern of specificity of movement between leaf and fruit that had been shown in *P. sativum* and *G. max* is clearly not the same for this variety of corn where no definite pattern of movement can be discerned. This is undoubtedly due in great part to the difference in vascular arrangement in these various species.

Conclusions: Unlike pea (*P. sativum*) and soybean (*G. max*), movement of P-32 from the leaf of corn subtending the reproductive organs at the 7th node is not predominantly to the reproductive organs at that node. Moreover, the pattern of movement from this node in corn is general and exhibits no specificity for the ear during any time of its development. It is also assumed as a result of these experiments that leaves other than the 7th may supply phosphate to the ear and that, in fact, the 7th leaf may supply other ears. It is suggested that this pattern of movement, results partly from the peculiarities of the vascular system of corn.

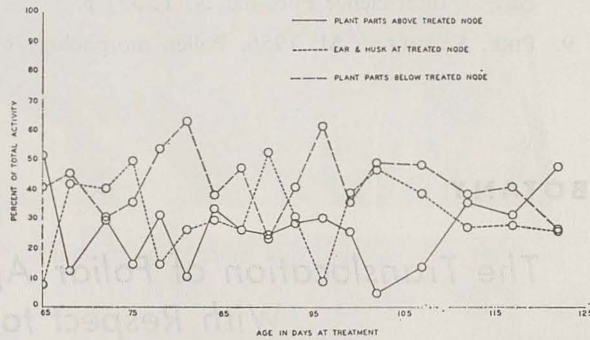

FIGURE 1. The percentage of the total amount of phosphorus-32 translocated from the 7th leaf to the plant parts above the treated leaf, below the treated leaf and to the ear and husk of corn.

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